SEASONALITY OF CICADAS (HEMIPTERA) ON THE NORTHERN TABLELANDS OF NEW SOUTH WALES

Marc Coombs

Department of Zoology, University of New England, Armidale, N.S.W. 2351

Present address: CSIRO Division of Entomology, PMB 3, Indooroopilly, Qld 4068

Abstract

Seasonality records are provided for 16 cicada species at sites near Armidale NSW, observed over 4 summers (1990-91 to 1993-94). Cicadas were active at these sites from late October to late February. The greatest number of species was present during December and early January. There was a significant, positive correlation of species number with day length in all years. Neither temperature nor rainfall consistently correlated with species number.

Introduction

A conspicuous feature of cicada biology is their predictable occurrence each year during summer. Though seasonality records are available for Australian species over their geographic range (Moulds 1990), there are no studies documenting seasonal patterns of occurrence on a regional basis. Regional differences in seasonality would be expected to occur as a consequence of regional climatic differences. This study was undertaken to document the seasonal activity of cicada species at sites near Armidale on the Northern Tablelands of New South Wales. Armidale experiences relatively mild summers (January average daily maximum, 27.1°C), and winters are cool to cold (July average daily maximum 12.4°C). The frost free period extends from November to March (30 y av.) (Bureau of Meteorology, unpubl. data). The Armidale climate is broadly representative of the New England Tablelands, a region extending from the township of Bendemeer (70 km south-west of Armidale) to Dorrigo (110 km east) and north to the Queensland border (Wallangarra).

Methods

The following localities were used as sampling sites in this study: The University of New England campus (30°29'S, 151°39'E), the 'Pinnacle' (30°30'S, 151°30'E), Dangars Falls (30°41'S, 151°44'E) and 'The Devils Pinch' (30°20'S, 151°40'E). All sites are within 20 km of Armidale and vary from *ca* 1000 to 1200 m above sea level. Each was visited during the second and fourth weeks of each month from August to April of the summers 1990-91, 1991-92, 1992-93 and 1993-94. The cicada species present on each sampling date were identified by sight or by song pattern. Cicada songs are species specific (Young 1972, Ewart 1989) and can be readily learnt for a given locality. To assess the influence of climate on seasonal activity, fortnightly averages of climatic and regional variables (max. and min. temperature, rainfall and photoperiod) were obtained for Armidale for the study periods. Data from the four sampling localities were pooled and analysed (Pearson product-moment correlation) against climatic and regional variables for each year of the study.

Table 1. Seasonality records for cicada species at Armidale, New South Wales, during the period October to February of the years 1990/91 to 1993/94. Each month is scored twice to represent sampling in the second and fourth week.

Species	Year	Month									
		O	O	N	N	D	D	J	J	F	F
Cicadetta	90/91			*	*	*	*	*			
waterhousei	91/92			*	*	*	*	*			
(Distant)	92/93				*	*	*	*			
	93/94			*	*	*	*	*	*		
Cicadetta	90/91			*	*	*	*	*	*	*	
labeculata	91/92				*	*	*	*	*	*	
(Distant)	92/93				*	*	*	*	*	*	
	93/94				*	*	*	*	*		
Cicadetta	90/91				*	*	*				
tristrigata	91/92				*	*	*	*	*		
(Goding &	92/93				*	*	*	*	*		
Froggatt)	93/94				*	*	*	*			
Cicadetta	90/91										
landsboroughi	91/92				*	*	*	*	*		
(Distant)	92/93				*	*	*	*	*		
	93/94					*	*	*	*		
Cicadetta puer	90/91			*	*	*	*	*	*	*	
(Walker)	91/92			*	*	*	*	*	*	*	
	92/93		*	*	*	*	*	*	*	*	
	93/94		*	*	*	*	*	*	*	*	
Urabunana	90/91			*	*	*	*	*	*		
marshalli	91/92				*	*	*	*			
Distant	92/93				*	*	*	*	*		
	93/94			*	*	*	*	*	*		
Urabunana	90/91				*	*	*	*			
wollomombii	91/92				*	*	*	*			
Coombs	92/93				*	*	*	*			
	93/94					*	*	*			
Birrima varians	90/91			*	*	*	*	*	*	*	
(Germar)	91/92			*	*	*	*	*	*	*	
	92/93			*	*	*	*	*	*	*	
	93/94			*	*	*	*	*	*	*	
Pauropsalta	90/91				*	*	*	*	*		
corticinus	91/92				*	*	*	*			
Ewart	92/93				*	*	*	*			
	93/94				*	*	*	*			

Pauropsalta	90/91	*	*	*	*	*	*	*	*	
collina Ewart	91/92	*	*	*	*	*	*	*	*	
	92/93	*	*	*	*	*	*	*	*	
	93/94	*	*	*	*	*	*	*	*	
Notopsalta sp.	90/91					*	*	*		
	91/92					*	*			
	92/93					*	*			
	93/94					*	*			
Cystosoma	90/91			*	*	*	*	*		
saundersii	91/92			*	*	*	*	*		
Westwood	92/93			*	*	*	*	*		
	93/94			*	*	*	*	*		
Cyclochila	90/91									
australasiae	91/92			*	*	*	*			
(Donovan)	92/93			*	*	*	*	*		
	93/94									
Macrotristria	90/91									
angularis	91/92									
(Germar)	92/93				*	*	*	*		
	93/94									
Psaltoda plaga	90/91				*	*	*	*	*	*
(Walker)	91/92				*	*	*	*	*	
	92/93				*	*	*	*	*	
	93/94				*	*	*	*	*	*
Psaltoda	90/91				*	*	*	*	*	
moerens	91/92				*	*	*	*		
(Germar)	92/93				*	*	*	*		
	93/94									

Results

In general, cicadas were active at the study sites from late October to late February. Within this period, species appeared at differing times and were active for varying durations over the summer. Seasonality records are provided for 16 species of cicada for each year of the study (Table 1). Most adults were active from late November to late January. *Pauropsalta collina* Ewart (all years) and *Cicadetta puer* (Walker) (1992-93 only) were the most persistent species, occurring from late October to early February. Only *Psaltoda plaga* (Walker) occurred until the end of February and none was present by March. A species tentatively assigned to the genus *Notopsalta* was active for the shortest period, from late December to late January. All species were remarkably consistent from year to year in their times of appearance and persistence through the season. Not all species, however, were present in all study years. *Macrotristria angularis* (Germar) was present in 1992-93 only, whilst *Cyclochila australasiae* (Donovan) and *Cicadetta*

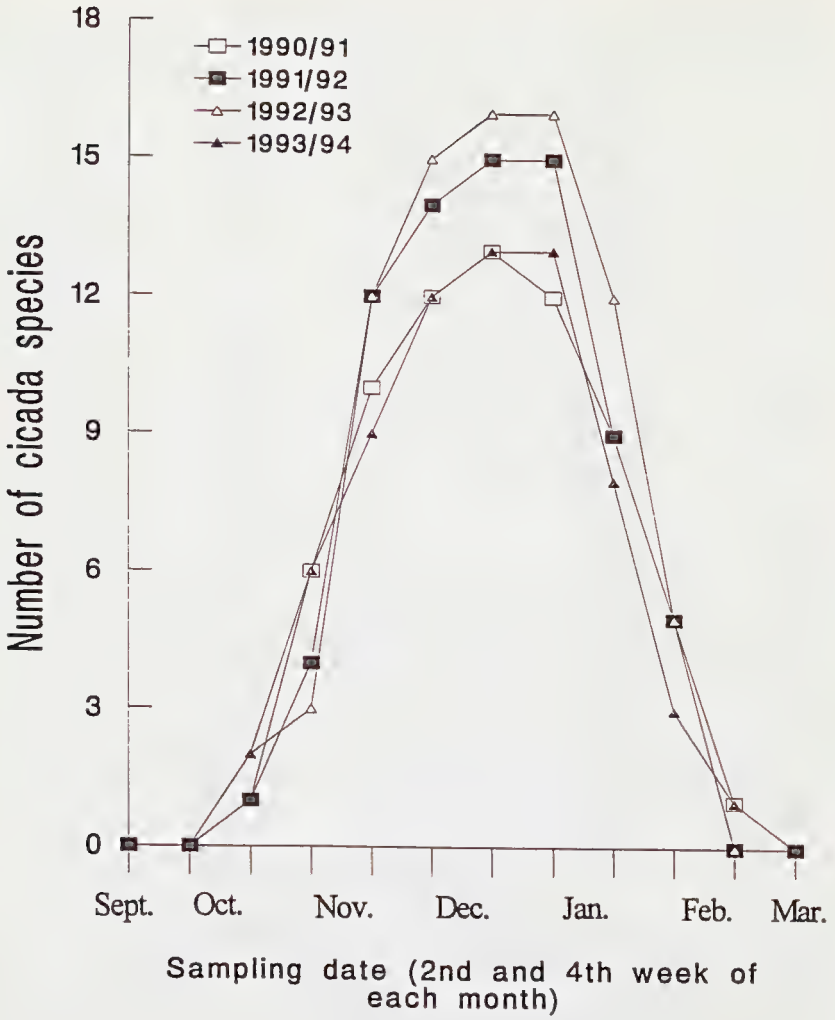

Fig. 1. Seasonal activity curve of cicada species at sites in the vicinity of Armidale, NSW during the period September to March of the years 1990-91, 1991-92, 1992-93 and 1993-94.

landsboroughi (Distant) were absent during 1990-91.

Figure 1 shows a plot of species number versus sampling date for each year of the study. Species number peaked during December to early January, and declined rapidly thereafter, with most species absent by late January. Pearson correlations and significance levels for species number against climatic and

Table 2 Pearson correlations for species number against maximum and minimum temperature (°C), rainfall (mm) and photoperiod (hours of daylight).

Year		Max.	Min.	Rainfall	Photoperiod
1990-91	r	0.783	0.684	0.337	0.865
	$t_{(12)}$	4.36	3.25	1.24	5.97
	P	< 0.01	< 0.01	> 0.2	< 0.01
1991-92	r	0.673	0.395	0.331	0.815
	$t_{(12)}$	3.15	1.49	1.21	4.87
	P	< 0.01	> 0.1	> 0.2	< 0.01
1992-93	r	0.427	0.581	0.738	0.822
	$t_{(12)}$	1.63	2.47	3.79	5.00
	P	> 0.1	< 0.05	< 0.01	< 0.01
1993-94	r	0.511	0.526	0.556	0.852
	$t_{(12)}$	2.06	2.14	2.32	5.64
	P	> 0.05	> 0.05	< 0.05	< 0.01

regional variables are shown in Table 2. Species number was significantly and positively correlated with day length in all years and with average maximum daily temperature during 1990-91 and 1991-92 but not 1992-93 or 1993-94. Correlations of species number with average minimum daily temperature were significant during 1990-91 and 1992-93 only. Species number was significantly correlated with rainfall during 1992-93 and 1993-94 but not 1990-91 or 1991-92.

Discussion

The seasonal activity of cicadas on the New England Tablelands appears to reflect dominant climatic conditions. The adverse (cool) season is spent below ground as immatures feeding on roots. The favourable (warm) season (as indicated by the frost free period) is relatively short, extending from November to March. The first adult cicadas appear during late October. The species per fortnight curve (Fig. 1) shows a rapid increase during November, peaking during December / January with a rapid decline in late January / February. Although significant correlations of species number with maximum or minimum daily temperature and rainfall occurred in some years, only photoperiod (hours of daylight) was significantly and positively correlated with species number in all years. Adult cicadas are strongly heliothermic. Adult reproductive behaviour is restricted to daylight hours in all species except the crepuscular *Cystosoma saundersii* Westwood. Clearly species are timing their seasonal appearance to coincide with the greatest duration of daylight hours. Such behaviour would enable individuals to maximise the time spent undertaking reproductive activities.

As adult cicadas are thought to be relatively short lived (usually about 2-4 weeks: Moulds 1990), variation observed in seasonal persistence between species may be a consequence of differences in the synchrony of adult emergence. Species present for several months (e.g. *P. collina*, *Birrima varians*) may have a staggered emergence, whereas shorter periods of seasonal activity (e.g. *Notopsalta* sp., *U. wollomombii*) may reflect greater synchrony in emergence.

The species activity curve presented here for cicadas on the New England Tablelands closely parallels activity patterns of other insect taxa at localities with short summers (Shapiro 1975, Wolda 1988). A short period of seasonal activity and a well defined seasonal peak appear to be typical of many insect faunas occupying either the higher latitudes or those occurring at altitude. Shapiro (1975) provides data on numbers of butterfly species in the Sierra Mountains (7000' altitude) of California largely restricted to a four month flight period. On average, cicadas on the New England Tablelands become active approximately one month later and disappear approximately one to two months earlier than would be expected when extracting seasonality data for the same species from Moulds (1990). Ewart (1989) provides seasonality records for *Pauropsalta* spp. from Queensland as extending from September to May.

Acknowledgment

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